“Maker Movement” Approach to Computing: The Internet of Things (INST 388I) v2

Term: *Spring 2026*

Professor: Dr. Dennis Frezzo
Pronouns: he/him
Email: dfrezzo@umd.edu
Office Hours: after class

Teaching Assistants: See Canvas
Email: See Canvas
Office Hours: See Canvas

Credits: 3

Class time and location:

- In-person in Hornbake 0302A.
- 4 weeks of Mondays 5:00-6:15 PM: April 13, 20, 27, May 4; 4 Weeks of Wednesdays 5:00-6:15 April 15, 22, 29, and May 6; and one extra out-of-class session in the Tinkerspace Wednesday 6:15-7:15, Tuesdays 3-4 or 4-5
- In-person lab consultations and office hours will be held in 0302A immediately after class on Wednesday, until 7:15 PM, and on Tuesday afternoons, 3:00-5:00 PM

Course Overview

The Internet of Things (IoT) refers to the interconnection of perhaps a trillion Internet-connected devices ranging from tiny "smart dust" sensors and actuators, embedded in almost any human-designed or living thing, to the Internet's "network of networks," to powerful cloud systems, including AI. IoT systems are sometimes called cyber physical systems. We will go from "zero" to "hero", building a "hello world" IoT system quickly. We will examine IoT systems in terms of messages among sensors and actuators; gateways and routers; LANs, WANs, and ISPs; cloud services; and mobile applications. Applications such as smart health, smart homes, smart cities, smart transportation, smart agriculture, and smart factories will be considered. The course will culminate in a student-chosen IoT project, with options for going more deeply into the hardware, software, networking, programming, or cloud aspects of IoT Systems.

Student Learning Outcomes

Upon successful completion of the course, students will be able to:

- Analyze the Internet of Things (IoT) as a system
- Analyze commercially available IoT systems
- Build simulation-based models of the Internet of Things
- Review case studies of available IoT systems with the prefix “smart” (smart home, smart cities, smart agriculture, etc.)
- Use a working IoT system using Arduino microcontrollers and Arduino Cloud
- Analyze the Internet as a system

Course Activities:

- In-Person: Tuesday, short lectures, hands-on lab activities, and tours.
- Online Activities: reading, watching, doing small tasks to be ready for class sessions or reflecting on sessions.

Classroom Community of Learners and Diversity and Inclusion

I feel mutual respect is a key for our classroom learning community. My approach is that I strive to be a "guide on the side", facilitating your learning, but all of you can teach me many things as well. For our classroom community, please seek help from your peers, the TA and the grader, and me. Most of our interactions can be guided by this fine website of course-related policies, including academic integrity. As a University of Maryland student, you have a Student Success support network. I am committed to teaching, supporting, and mentoring everyone in their uniqueness. The University has various networks supporting diversity that may interest you.

I will not allow the use of smartphones in class and will expect use of computers to be limited class activities.

No phones or tablet devices are permitted during our class meetings: I understand and have considered arguments for permitting tablet computers and phones in the classroom. However, in my experience (and based on the research evidence) the reality is that they present an irresistible distraction and detract from the cooperative learning environment. I will allow laptops because of the software-intensive nature of this course, but I should not see you using anything other than the applications related to the course. Researchers have found that these distractions do in fact interfere with learning and active participation. For that reason, the use of tablets and phones will not be permitted during class meetings (except when required for DSS accommodations). In the case where a student requests/needs a computer as part of an accommodation, the overall classroom policy will be adjusted to allow all students to use computers. I expect you to make the responsible and respectful decision to refrain from using your cellphone in class. If you have critical communication to attend to, please excuse yourself and return when you are ready. For more information about the science behind the policy watch: http://youtu.be/WwPaw3Fx5Hk.

Required Textbook(s)/Resources/Equipment:

- Course Website: elms.umd.edu
- Required Textbook: none
- Other supplemental reading via eBooks available through the library Course Reserves, links within ELMS
- Laptop (or desktop) computer onto which you can install software, and with an Internet Connection to ELMS and other services for labs and activities:
    - Cisco Packet Tracer (enrollment in Cisco Networking Academy required)
    - Arduino IDE, Wireshark, Netspot
    - Other Free Software as required
- Suggested Not Required: USB 3.0 to USB C adapter or hub

Course Structure

Each week will follow this pattern, with rare exceptions:

- Work at home and pre-labs: readings, videos, and tasks to be completed before class time.
- Lecture and Lab: On 4 Mondays and 4 Wednesdays, on-time attendance and participation and "write-up" required.
- Final Project with Presentation
- Final Course reflection.

Tips for Success in this Course

1. **Participate.** I invite you to engage deeply, ask questions, and talk about the course content with your classmates. You can learn a great deal from discussing ideas and perspectives with your peers and professor. Participation can also help you articulate your thoughts and develop critical thinking skills.
2. **Manage your time.** Students are often very busy, and I understand that you have obligations outside of this class. However, students do best when they plan adequate time that is devoted to course work. Block your schedule and set aside plenty of time to complete assignments including extra time to handle any technology related problems.
3. **Login regularly.** I recommend that you log in to ELMS-Canvas several times a week to view announcements, discussion posts and replies to your posts. You may need to log in multiple times a day when group submissions are due.
4. **Do not fall behind.** This class moves at a quick pace and each week builds on the previous content. If you feel you are starting to fall behind, check in with the instructor as soon as possible so we can troubleshoot together. It will be hard to keep up with the course content if you fall behind in the pre-work or post-work.
5. **Use ELMS-Canvas notification settings.** Pro tip! Canvas ELMS-Canvas can ensure you receive timely notifications in your email or via text. Be sure to enable announcements to be sent instantly or daily.
6. **Ask for help if needed.** If you need help with ELMS-Canvas or other technology, IT Support. If you are struggling with a course concept, reach out to me and your classmates for support.

Policies and Resources for Undergraduate Courses

It is our shared responsibility to know and abide by the University of Maryland's policies that relate to all courses, which include topics like:

- Academic integrity
- Student and instructor conduct
- Accessibility and accommodations
- Attendance and excused absences
- Grades and appeals
- Copyright and intellectual property

Please visit www.ugst.umd.edu/courserelatedpolicies.html for the Office of Undergraduate Studies' full list of campus-wide policies and follow up with me if you have questions.

Course Guidelines

Names/Pronouns and Self-Identifications:

The University of Maryland recognizes the importance of a diverse student body, and we are committed to fostering inclusive and equitable classroom environments. I invite you, if you wish, to tell us how you want to be referred to in this class, both in terms of your name and your pronouns (he/him, she/her, they/them, etc.). Keep in mind that the pronouns someone uses are not necessarily indicative of their gender identity. Visit trans.umd.edu to learn more.

Additionally, it is your choice whether to disclose how you identify in terms of your gender, race, class, sexuality, religion, and dis/ability, among all aspects of your identity (e.g., should it come up in classroom conversation about our experiences and perspectives) and should be self-identified, not presumed or imposed. I will do my best to address and refer to all students accordingly, and I ask you to do the same for all of your fellow Terps.

Communication with Instructor:

Email: If you need to reach out and communicate with me, please email me at dfrezzo@umd.edu. Use the subject line "388 inquiry." Please refer to the syllabus or look on ELMS before emailing me a question (i.e. When is this assignment due? How much is it worth? etc.). I am likely to refer you to those resources if they contain the answer. Please feel free to reach out about personal, academic, and intellectual concerns/questions.

I will do my best to respond to emails within 24 hours. However, I am unlikely to respond to inquiries outside of normal business hours (Monday through Friday, 9:00am-5:00pm eastern). If you do not receive a response after 48 hours, it is appropriate to politely inquire if I have received your message.

ELMS: I will send IMPORTANT announcements via ELMS messaging. You must make sure that your email & announcement notifications (including changes in assignments and/or due dates) are enabled in ELMS so you do not miss any messages. You are responsible for checking your email and Canvas/ELMS inbox with regular frequency.

Please do not use ELMS messaging to contact me under normal circumstances. However, if you believe your email was not received, then sending an ELMS message is appropriate method to debug that issue. Please refrain from sending me the same question multiple times through multiple communication channels.

Communication with Peers:

With a diversity of perspectives and experience, we may find ourselves in disagreement and/or debate with one another. As such, it is important that we agree to conduct ourselves in a professional manner and that we work together to foster and preserve a virtual classroom environment in which we can respectfully discuss and deliberate controversial questions. I encourage you to confidently exercise your right to free speech—bearing in mind, of course, that you will be expected to craft and defend arguments that support your position. Keep in mind, that free speech has its limit, and this course is NOT the space for hate speech, harassment, and derogatory language. I will make every reasonable attempt to create an atmosphere in which each student feels comfortable voicing their argument without fear of being personally attacked, mocked, demeaned, or devalued.

Any behavior (including harassment, sexual harassment, and racially and/or culturally derogatory language) that threatens this atmosphere will not be tolerated. Please alert me immediately if you feel threatened, dismissed, or silenced at any point during our semester together and/or if your engagement in discussion has been in some way hindered by the learning environment.

Major Assignments

In-Person Participation (aka “Labs”) and Postings

- Activities that will help you explore and understand the material through practical application or discussion.
- Students are expected to work in pairs to complete these exercises, in class
- Labs are graded on a rubric that considers both accuracy and effort. Maximum points are awarded for correct answers that are well explained and demonstrate engagement with the material.
- Make-up for in-person hands-on labs (lowest dropped, only 1 excused absence allowed) will require a >= 1 hour make-up appointment.

Homework Assignments

- Reading, Watching, and Doing outside of class. More details in ELMS.

Project

- Every student will complete a guided IoT project

Reflection

- There is no final exam for this course. There is a final take-home reflection. Details in ELMS.

Grading Structure

Assignment	%
In-Person Participation in Weekly Lab Monday and Wednesday Lab (8 sessions, not just attendance, but satisfactory participation) with reflections due the night of the lab, extensions graded @ 90% basis for Wednesday; 80% for Thursday; 70% for subsequent Friday, Saturday, Sunday, Monday, Tuesday; 0% after). Lowest score dropped. Plus one excused absences can be madeup. Missing >= 4 session = automatic F, without chances of makeup. To Pass, you need 70% overall average score and at least 6 lab credits, that’s a Boolean AND!	**56%**
Pre-Lab and Homework Assignments (due graded on a 100% basis; extensions graded @ 90% basis for day after due date; 80% for 2 days after; 70% for subsequent 5 days, 0% after). Lowest score dropped. No makeups after closing date.	**28%**
Final Project – No score dropped. Makeup must be scheduled at Instructor convenience.	**8%**
Final Reflection Due May 10, accepted with late penalty until May 17	**8%**
Total	**100 %**

Your grade is determined by your performance on the assessed components in the course.

I often use 1-point rubrics – this does not mean a low point value; we are using weighted averages. One point rubrics are often effort/no effort, or pass/fail, grading.

All assessment scores will be posted on Canvas. If you would like to discuss your grade, or have questions about how something was scored, please schedule a time with the course TA or with the instructor. Grade disputes must be turned in within one week of receiving the graded work. They must be submitted as a written document (via email to the TA and professor) in which you indicate the graded work, an explanation of what you believe was mis-graded, and an explanation for why you think it should be given a different score. For any re-grade request, the entire assignment will be regarded, and your score may go up or down. Scores on each component will be combined to produce a single overall score for each student:

Academic Integrity

For this course, some of your assignments will be collected via Turnitin on our course ELMS page. I have chosen to use this tool because it can help you improve your scholarly writing and help me verify the integrity of student work. For information about Turnitin, how it works, and the feedback reports you may have access to, visit Turnitin Originality Checker for Students

The University's Code of Academic Integrity is designed to ensure that the principles of academic honesty and integrity are upheld. In accordance with this code, the University of Maryland does not tolerate academic dishonesty. Please ensure that you fully understand this code and its implications because all acts of academic dishonesty will be dealt with in accordance with the provisions of this code. All students are expected to adhere to this Code. It is your responsibility to read it and know what it says, so you can start your professional life on the right path. **As future professionals, your commitment to high ethical standards and honesty begins with your time at the University of Maryland.**

It is important to note that course assistance websites, such as CourseHero, or AI generated content are not permitted sources, unless the instructor explicitly gives permission. Material taken or copied from these sites can be deemed unauthorized material and a violation of academic integrity. These sites offer information that might be inaccurate or biased and most importantly, relying on restricted sources will hamper your learning process, particularly the critical thinking steps necessary for college-level assignments.

Additionally, students may naturally choose to use online forums for course-wide discussions (e.g., Group lists or chats) to discuss concepts in the course. However, collaboration on graded assignments is strictly prohibited unless otherwise stated. Examples of prohibited collaboration include: asking classmates for answers on quizzes or exams, asking for access codes to clicker polls, etc. Please visit the **Office of Undergraduate Studies' full list of campuswide policies** and reach out if you have questions.

Please review the Course-Related Policies and Resources for Undergraduate Students.

Please review the University of Maryland Code of Academic Integrity.

Please note the that process for any of us who suspects, witnesses, or wishes-to-self-report-upon-reflection an Academic Integrity issue, is to complete an Academic Integrity Referral Form.

Finally, on each exam or assignment you must write out and sign the following pledge: ***"I pledge on my honor that I have not given or received any unauthorized assistance on this exam/assignment."*** If you ever feel pressured to comply with someone else's academic integrity violation, please reach out to me straight away. Also, ***if you are ever unclear*** about acceptable levels of collaboration, ***please ask***! To help you avoid unintentional violations, ***the following table*** lists levels of collaboration that are acceptable for each graded exercise. Each assignment will contain more specific information regarding acceptable levels of collaboration.

Special note on Generative AI Tools

Generative AI tools, like ChatGPT, exist and are increasingly accessible as they are integrated into search engines, operating systems, and other common computing technologies. These tools are powerful and understanding how to use them effectively is an important skill. I would prefer that you not use these tools because shortcuts to the answer bypass the learning process, but it would be disingenuous to believe that AI tools will not be used. Therefore, it is important to establish guidance about permissible usage within the context of this course.

AI tools are a resource that fall under the category of "Collect Answers Online" in the table above and are not permitted for the categories listed.

Where AI tools are permitted be aware that:

- AI tools must be cited like any other external resource. The citation should include the specific tool used and the prompt used to general the information.
- Uncited use of generative AI tools will be considered a violation of the academic integrity and reported accordingly. Using a generative AI tool to complete an exam, in part or in full, is cheating.
- You are ultimately responsible for what you submit. AI tools will provide incorrect answers just as readily as they provide incorrect answers, it is your responsibility to verify any information that you provide.
- You should not copy-and-paste directly from an AI tool or submit an assignment where the content was not written by you or a member of your team. If an assignment reads like it was written by a generative AI tool, you may be asked to resubmit.

Grades
Grades are not given but earned. Your grade is determined by your performance on the learning assessments in the course and is assigned individually (i.e. - not curved). If earning a particular grade is important to you, please speak with me at the beginning of the semester so that I can offer some helpful suggestions for achieving your goal.

The definition of an "A+" is work that is truly outstanding or exceptional. It is not only a matter of the hours or effort put in to completing the work. To earn an A+ the work must be correct, and it must go beyond the expectations of the assignment.

All assessment scores will be posted on the course ELMS page. If you would like to review any of your grades (including the exams), or have questions about how something was scored, please email me to schedule a time for us to meet in my office.

Any formal grade disputes must be submitted in writing and within one week of receiving the grade.

Late Work

- Unless arrangements are made 24 hours before the due date, and only a limited number of arrangements (excused absences) will be granted, the following policy applies:
    - Pre-labs: due Tuesdays at Classtime; Work accepted until the following Tuesday night.
    - Tuesday In-Person Sessions – write-up due the night of the lab, work accepted until the following Tuesday night. Make-ups required in-person for hands-on labs beyond one missed.
    - No late work will be accepted after Reading Day.

If you have a legitimate reason, such as a major medical or family emergency, I may agree to an extension or makeup work. Documentation of the emergency (e.g. a doctor's letter) may be required. Grading is prioritized for feedback for on-time submissions. Late submissions (even with an approved extension) will be graded as the team's schedule allows and are likely to incur delays.

Final Grade Cutoffs
Final letter grades are assigned based on the percentage of total assessment points earned. To be fair to everyone I must establish clear standards and apply them consistently, so please understand that being close to a cutoff is not the same this as making the cut ($89.99 \neq 90.00$). It would be unethical to make exceptions for some and not others. If you need a specific grade to attain a personal goal or academic requirement, then I am happy to talk with you about those goals at the beginning of the semester and suggest strategies to meet those needs.

Final Grade Cutoffs									
+	97.00%	+	87.00 %	+	77.00 %	+	67.00 %	+	
A	93.00%	B	83.00 %	C	73.00 %	D	63.00 %	F	<60. 0%
-	90.00%	-	80.00 %	-	70.00 %	-	60.00 %	-	

Course Outline

The format of this section will vary based on the design of your course and the semester, but our guidance is to aim for a clear and concise table that maps out all the assignment assessments and deadlines and gives students a sense of the course's organization.

Module #	Date (Mon)	Topic (Subject to Change)	Deliverable
01	**Apr 13**	IoT Systems all around us What are Things? What is the Internet? Analyzing IoT system as components Manipulating IoT components	**See Canvas**
02	**Apr 20**	Electronics (Circuits), Networking (Tabletop), and Cloud Computing for IoT systems	**See Canvas**
03	**Apr 27**	Building a Rack Model of the IoT	**See Canvas**
04	**May 4**	Study Example "Smart" Systems Affordances of the Arduino IoT Ecosystem	**See Canvas**
05	**May 11**	Final IoT Project (sensor to cloud to actuator with dashboard) demonstrated, analyzed, and explained	**See Canvas**

Note: This is a tentative schedule, and subject to change as necessary – monitor the course ELMS page for current deadlines. In the unlikely event of a prolonged university closing, or an extended absence from the university, adjustments to the course schedule, deadlines, and assignments will be made based on the duration of the closing and the specific dates missed.

Resources & Accommodations

Accessibility and Disability Services

The University of Maryland is committed to creating and maintaining a welcoming and inclusive educational, working, and living environment for people of all abilities. The University of Maryland is also committed to the principle that no qualified

individual with a disability shall, on the basis of disability, be excluded from participation in or be denied the benefits of the services, programs, or activities of the University, or be subjected to discrimination. The **Accessibility & Disability Service (ADS)** provides reasonable accommodations to qualified individuals to provide equal access to services, programs and activities. ADS cannot assist retroactively, so it is generally best to request accommodations several weeks before the semester begins or as soon as a disability becomes known. Any student who needs accommodations should contact me as soon as possible so that I have sufficient time to make arrangements.

For assistance in obtaining an accommodation, contact Accessibility and Disability Service at 301-314-7682, or email them at **adsfrontdesk@umd.edu**. Information about **sharing your accommodations with instructors**, **note taking** **assistance** and more is available from the **Counseling Center**.

Student Resources and Services

Taking personal responsibility for your own learning means acknowledging when your performance does not match your goals and doing something about it. I hope you will come talk to me so that I can help you find the right approach to success in this course, and I encourage you to visit **UMD's Student Academic Support Services website** to learn more about the wide range of campus resources available to you.

In particular, everyone can use some help sharpening their communication skills (and improving their grade) by visiting **UMD's Writing Center** and schedule an appointment with the campus Writing Center.

You should also know there are a wide range of resources to support you with whatever you might need (**UMD's** **Student Resources and Services website** may help). If you feel it would be helpful to have someone to talk to, visit **UMD's Counseling Center** or **one of the many other mental health resources on campus**.

Basic Needs Security

If you have difficulty affording groceries or accessing sufficient food to eat every day, or lack a safe and stable place to live, please visit **UMD's Division of Student Affairs website** for information about resources the campus offers you and let me know if I can help in any way.

Veteran Resources

UMD provides some additional supports to our student veterans. You can access those resources at the office of Veteran Student life and the Counseling Center. Veterans and active duty military personnel with special circumstances (e.g., upcoming deployments, drill requirements, disabilities) are welcome and encouraged to communicate these, in advance if possible, to the instructor.

Participation

- Given the interactive style of this class, attendance will be crucial to note-taking and thus your performance in this class. Attendance is particularly

important also because class discussion will be a critical component for your learning.

- Each student is expected to make substantive contributions to the learning experience, and attendance is expected for every session.
- Students with a legitimate reason to miss a live session should communicate in advance with the instructor, except in the case of an emergency.
- Students who miss a live session are responsible for learning what they miss from that session.
- Additionally, students must complete all readings and assignments in a timely manner in order to fully participate in class.

Course Evaluation

Please submit a course evaluation through Student Feedback on Course Experiences in order to help faculty and administrators improve teaching and learning at Maryland. All information submitted to Course Experiences is confidential. Campus will notify you when Student Feedback on Course Experiences is open for you to complete your evaluations at the end of the semester. Please go directly to the **Student Feedback on Course Experiences** to complete your evaluations. By completing all of your evaluations each semester, you will have the privilege of accessing through Testudo the evaluation reports for the thousands of courses for which 70% or more students submitted their evaluations.

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